Biologically Innovative Operations for Building Universal Infrastructure with Lean Durable Systems (BIO-BUILDS)

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What if we could deliver rapid and durable infrastructure by transforming local soils through microbial biocementation?

Applicant Type: Entity

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The ***Biologically Innovative Operations for Building Universal Infrastructure with Lean Durable Systems (BIO-BUILDS)*** project addresses a fundamental gap in how transportation infrastructure is constructed, protected, and sustained under increasing stress from damaging flood events. Today's approaches rely on centralized material production, long-distance transport of aggregates, and time-intensive construction processes that are poorly suited for rapid response, remote environments, or supply chain disruptions. As a result, flood-related damage alone causes billions of dollars of direct damage annually, while existing solutions remain slow to deploy, costly to maintain, and vulnerable to failure from erosion, seepage, and environmental degradation. The central mission of this effort is that infrastructure can be built faster, cheaper, and more durably by transforming locally available soils into structural materials using engineered biological processes.

The proposed solution leverages microbially induced calcite precipitation (MICP), a natural process in which bacteria form mineral bonds between soil particles, effectively creating stone-like materials in place. This project advances the state of the art by integrating emerging innovations in the MICP and bioengineered textile fields into a unified construction system, enabling a rapid, low-complexity deployment method that converts local soils and aggregates into permanent infrastructure through in situ mineralization. This approach replaces conventional concrete supply chains with distributed, on-site production using local materials, significantly reducing logistics and enabling rapid deployment.

The program is structured as a 36-month, phased R&D effort with project costs totaling $2.1 M, and is designed to reduce technical risk and enable transition of the technology into the commercial sector. Early phases focus on technical feasibility, foundational process optimization, and laboratory-scale material performance validation. Subsequent phases emphasize field demonstration, long-term performance monitoring and validation, and alignment with real-world operational requirements. Success will be measured through quantitative material performance and economic metrics benchmarked to current materials and practices.

The transition and commercialization strategy targets both government and commercial markets. Initial adoption is expected among federal and state agencies responsible for flood mitigation and transportation infrastructure, including organizations that define design standards and oversee system performance. Parallel commercialization pathways focus on emergency response, coastal protection, and construction markets that benefit from rapid, modular, and scalable solutions. The approach is designed to integrate with existing construction practices while enabling new capabilities, lowering barriers to adoption.

If successful, BIO-BUILDS will establish a new paradigm for infrastructure construction based on distributed, biologically enabled material production. The expected impact includes faster project delivery, reduced life cycle costs, improved resilience to climate-driven hazards, and decreased dependence on vulnerable supply chains. By enabling infrastructure to be built using local resources with minimal logistics, this technology has the potential to transform how the United States designs, constructs, and maintains critical transportation systems.